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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/677,159	10/01/2003	David E. Lowell	200300561-1	8180

22879 7590 04/08/2008

HEWLETT PACKARD COMPANY
P O BOX 272400, 3404 E. HARMONY ROAD
INTELLECTUAL PROPERTY ADMINISTRATION
FORT COLLINS, CO 80527-2400

EXAMINER	
ZHE, MENG YAO	
ART UNIT	**PAPER NUMBER**
2195	

NOTIFICATION DATE	DELIVERY MODE
04/08/2008	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

JERRY.SHORMA@HP.COM
mkraft@hp.com
ipa.mail@hp.com

Office Action Summary	Application No.	Applicant(s)	
	10/677,159	LOWELL, DAVID E.	
	Examiner	Art Unit	
	MENGYAO ZHE	2195	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *01 October 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-67* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-67* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *01 October 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-67 are presented for examination.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 1-67 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

A. The following terms lack proper antecedent basis:

i) Claim 29, "the virtual machine monitor"

B. The claim languages in the following claim languages are unclear and indefinite:

i) Claim 1, line 3, it is uncertain if "the memory" to be virtualized is the entire memory of the computer system <i.e. does it only virtualize a portion of the memory or the entire memory?>.

Claims 13, 28, 36, 44, 56 have the same deficiencies as above.

ii) Claim 16, it is unclear in terms of the role that the virtual machine monitor plays after devirtualization <i.e. Claim 13 defines the operating

system to be running on the virtual machine monitor. However, lines 7-8 of claim 16 say that the virtual machine monitor stops the translation process during devirtualization. However, after devirtualization, the operating system of the virtual machine monitor continues to be used for its mapping abilities. So is the system still devirtualized after devirtualization?>

Claim 47 has the same deficiencies as claim 16 above.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 1-2, 4-5, 10, 12-19, 25, 27-30, 35-38, 43-50, 55-62, 67 are rejected under 35 U.S.C. 102(b) as being anticipated by Bean et al., Patent No. 4,843,541 (hereafter Bean).

6. As per claim 1, Bean teaches a method of running a virtual machine monitor on computer hardware, the hardware including memory, the method comprising commencing virtualization of the memory at runtime (Column 22, lines 47-55; Column 29, lines 35-50).

7. As per claim 2, Bean teaches wherein the virtualization includes constructing an Identity mapping of physical to machine memory (Column 28, lines 33-41; Column 29, lines 35-50: Guest real address corresponds to physical memory, host absolute address corresponds to machine memory); and commencing to use the virtual machine monitor at runtime to manage memory translation (Column 2, lines 28-40: VM host corresponds to virtual machine monitor).

8. As per claim 4, Bean teaches wherein the memory translation is initially performed according to the Identity mapping (Column 29, lines 35-50).

9. As per claim 5, Bean teaches wherein the virtual machine monitor modifies the mapping after the physical memory has been virtualized (Column 22, lines 46-55).

10. As per claim 10, Bean teaches wherein only a portion of physical memory is virtualized at runtime (Column 22, lines 47-55: some memory resource may belong to host only, instead of guest and is hence not virtualized).

11. As per claim 12, Bean teaches performing runtime devirtualization of the virtualized memory (Column 22, lines 47-55).

12. As per claims 13, 44, 56, Bean teaches a method of running a virtual machine monitor on computer hardware and an operating system on the virtual machine monitor, the hardware including memory, the memory virtualized by the virtual machine monitor, the method comprising devirtualizing the memory at runtime (Column 22, lines 47-55; Column 29, lines 33-55: memory resources that were originally assigned to a virtual machine guest and is later assigned to the host is considered from being virtualized to being devirtualized, since the host uses real addresses while the virtual machine uses virtual addresses.).

13. As per claims 14, 45, 57, Bean teaches wherein a portion of the memory is devirtualized (Column 22, lines 47-55).

14. As per claims 15, 46, 58, Bean teaches wherein when the operating system is booted, the virtual machine monitor exposes the booting operating system to physical memory no larger than machine memory, where the physical memory does not span any memory holes (Column 1, lines 55-58: for a V=R guest, the virtual address

correspond directly to the real address, therefore it can't be larger than the machine memory.).

15. As per claims 16, 47, 59, Bean teaches wherein the operating system defines virtual-to-physical translations prior to the runtime devirtualization (Column 30, lines 5-8); wherein the virtual machine monitor defines physical-to-machine translations prior to the runtime devirtualization (Column 29, lines 30-45); wherein the virtual machine monitor composes dynamically the virtual-to-physical translations with the physical-to-machine translations prior to the runtime devirtualization, wherein the runtime devirtualization includes having the virtual machine monitor cease to perform the dynamic composition of translations; and wherein following the runtime devirtualization memory translation is performed by directly using the virtual-to-physical mapping defined by the operating system (Column 22, lines 47-55; Column 29, lines 33-55: when the memory resource is assigned to a guest, composite translation is necessary, however, when it gets assigned to the host, that memory is devirtualized, and translation is no longer necessary.).

16. As per claims 17, 48, 60, Bean teaches wherein the devirtualization includes remapping physical memory so a physical-to-machine mapping becomes an Identity mapping; and using the operating system to manage address translation with respect to the devirtualized memory (Column 29, lines 45-50; Column 30, lines 5-8).

17. As per claims 18, 49, 61, Bean teaches wherein pages of physical memory that are already Identity-mapped are not remapped, and wherein at least some other pages of physical memory are remapped directly (Column 22, lines 47-55; Column 29, lines 33-55: memory resources that are already part of the host do not need to be remapped, only the memory that originally belonged to a guest needs to be remapped.).

18. As per claims 19, 50, 62, Bean teaches wherein pages of physical memory that are already Identity-mapped are not remapped, and wherein at least some other pages of physical memory are remapped indirectly (Column 22, lines 47-55; Column 29, lines 33-55).

19. As per claim 25, Bean teaches wherein the remapping is performed without a back map by constructing a list of the physical pages mapping to a page of machine memory by searching the physical-to-machine mapping (Column 29, lines 35-50).

20. As per claims 27, 55, 67, Bean teaches wherein managing the address translation includes having the virtual machine monitor cease to compose dynamically the operating system's virtual-to-physical translations with the virtual machine monitor's physical-to-machine translations for a portion of physical memory that is devirtualized

(Column 22, lines 47-55; Column 29, lines 33-55: it is inherent that once the memory is devirtualized, the composite translation no longer occurs.).

21. As per claims 28, 36, Bean teaches a computer comprising memory including first and second portions, the first portion encoded with a virtual machine for commencing virtualization of the second portion at runtime (Column 22, lines 47-55; Column 29, lines 33-55).

22. As per claims 29, 37, Bean teaches wherein the virtualization includes constructing an Identity mapping of physical to machine memory; and commencing to use the virtual machine monitor at runtime to manage memory translation (Column 29, lines 45-48).

23. As per claims 30, 38, Bean teaches wherein the virtual machine monitor modifies the mapping after the physical memory has been virtualized (Column 22, lines 47-55).

24. As per claims 35, 43, Bean teaches wherein only a portion of physical memory is virtualized at runtime (Column 22, lines 47-55: those memory resources belonging to the host is not virtualized.).

Claim Rejections - 35 USC § 103

25. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

26. Claims 6-9, 11, 26, 31-34, 39-42, 54, 66 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bean et al., Patent No. 4,843,541 (hereafter Bean).

27. As per claims 6, 31, 39, Bean teaches wherein the memory translation is managed by allowing the operating system to define virtual-to-physical mapping (Column 30, lines 3-8), and the virtual machine monitor to define physical-to machine mapping (Column 29, lines 44-50).

Bean does not specifically teach wherein an operating system is running on the virtual machine monitor prior to virtualizing the memory. However, since initializing the virtual machine monitor with its running operating system before setting any other guest virtual machines on top of the virtual machine monitor is generally well known in the field of virtual machines, it would have been obvious to one having ordinary skill in the art at the time of the applicant's invention to allow the operating system for virtual machine monitor to run prior to virtualization of the memory.

28. As per claims 32, 40, Bean teaches wherein the virtual machine monitor dynamically composes virtual-to-physical translations with the physical-to-machine translations (Column 29, lines 35-55).

29. As per claims 33, 41, Bean teaches wherein the virtual machine monitor inspects the virtual-to-physical mappings by the operating system and maintains page tables of virtual-to-machine mappings (Column 29, lines 35-55).

30. As per claims 34, 42, Bean teaches wherein a translation lookaside buffer is loaded with the virtual-to-machine translations (Column 30, lines 20-25).

31. As per claim 7, Bean teaches wherein the virtual machine monitor dynamically composes virtual-to-physical translations with physical-to-machine translations (Column 6, lines 35-50).

32. As per claim 8, Bean teaches wherein the virtual machine monitor inspects the virtual-to-physical mappings by the operating system and maintains page tables of virtual-to-machine mappings (Column 29, lines 35-50).

33. As per claim 9, Bean teaches loading a translation lookaside buffer with virtual-to-machine translations (Column 30, lines 20-25).

34. As per claim 11, Bean teaches virtualizing both the CPU and the memory (Colum 22, lines 61-68). However, Bean does not specifically teach that the CPU must be virtualized prior to the virtualization of the memory. However, since the order of hardware virtualization does not matter in the field of virtual machines, it would have been obvious to one having ordinary skill in the art to virtualize all hardware in any preferred order, including CPU before memory.

35. As per claims 26, 54, 66, Bean does not specifically teach wherein managing the address translation includes having the virtual machine monitor cease to inspect the operating system's virtual-to-physical translations; and ceasing to maintain a page table of direct virtual-to-machine mappings. However, Bean teaches assigning memory from a guest to a host, therefor devirtualizing the memory that was originally intended for the guest (Column 22, lines 47-55). It would have been obvious to one having ordinary skill in the art at the time of the applicant's invention that the composite translation will stop since that memory no longer belongs to the guest that needs virtual memory.

36. Claims 20-22, 51-53, 63-65 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bean et al., Patent No. 4,843,541 (hereafter Bean) in view of Chu, Patent No. 6,256,657 (hereafter Chu).

37. As per claims 20, 51, 63, Bean does not specifically teach wherein the remapping of the physical memory is performed concurrently with operating system and application activity.

However, Chu teaches operating system and related activities performs remapping, thus remapping occurs concurrently with operating systems for the purpose of having the operating system perform the job of remapping (Column 6, lines 56-67).

It would have been obvious to one having ordinary skill in the art at the time of the applicant's invention to combine the teachings of Bean with wherein the remapping of the physical memory is performed concurrently with operating system and application activity, as taught by Chu, because it allows the operating system to perform remapping.

38. As per claims 21, 22, 52, 64, 53, 65, Chu teaches preventing the physical-to-machine mapping from being modified during the remapping, and temporarily preventing some or all write accesses to memory (Column 9, lines 60-Column 10, line 18).

39. Claims 23-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bean et al., Patent No. 4,843,541 (hereafter Bean) in view of Waldspurger, Patent No. 6,789,156 (hereafter Waldspurger).

40. As per claim 23, Bean does not specifically teach maintaining a back map that contains for each page of machine memory a list of the pages of physical memory that map to it, and a list of free machine pages.

However, Waldspurger teaches a back map for the purpose of identifying all the contexts that are sharing the same memory page, or in other words, all contexts that are mapped onto the same page. (Column 14, lines 17-24; Column 29, lines 27-28).

It would have been obvious to one having ordinary skill in the art at the time of the applicant's invention to combine the teachings of Bean with maintaining a back map, as taught by Waldspurger, because it allows the system to identify all contexts that are mapped to the same page.

41. As per claim 24, Waldspurger teaches wherein the remapping is performed without a back map by maintaining a reference count for each machine page is kept, and freeing machine pages when their reference counts are zero (Column 14, lines 12-43; Column 20, lines 29-33).

42. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bean et al., Patent No. 4,843,541 (hereafter Bean) in view of Bugnion et al., Patent No. 6,296,847 (hereafter Bugnion).

43. As per claim 3, Bean does not specifically teach wherein mapping is constructed prior to runtime.

However, Bugnion teaches mapping may be constructed before the run time of virtual machine for the purpose of mapping restoration (Column 14, lines 50-55).

44. It would have been obvious to one having ordinary skill in the art at the time of the applicant's invention to modify the teachings of Bean with mapping is constructed prior to runtime, as taught by Bugnion, for the purpose of mapping restoration.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MENGYAO ZHE whose telephone number is (571)272-6946. The examiner can normally be reached on Monday Through Friday, 7:30 - 5:00 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Meng-Ai An can be reached on 571-272-3756. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Lewis A. Bullock, Jr./
Supervisory Patent Examiner, Art Unit 2193